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(12) # EUROPEAN PATENT APPLICATION

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(54) **Process for producing a composition to be used in road paving.**

(57) To produce a composition to be used in road paving, mineral constituents such as gravel and/or crushed stone and sand with a bituminous binder are mixed in a mixer. To improve the strength characteristics of asphalt layers made with such a mixture in a simple, relatively cheap way chopped bundles of glass or mineral fibres are added to the composition in a percentage by mass of 0.2 - 0.8 with respect to the mineral constituents, the length of the filaments being between 5 and 50 mm, the diameter of the filaments at least 1 micrometer, and an adhesion-promoting protective coating being provided on the fibres. It is essential for the invention that the fibres are added in the mixture and not on the road and that the glass or mineral fibres are introduced into the composition in the form of bundles chopped to certain lengths.

Process for producing a composition to be used in road paving.

The invention relates to a process for producing a composition to be used in road paving, comprising mixing mineral constituents such as gravel and/or crushed stone and sand with a bituminous binder in a mixer.

Lorry traffic is increasing annually in many countries in the world; not only has the number of lorries increased, but also the average axle loading. Ever increasing requirements are therefore being imposed on the paving of asphalt roads. The conventional road paving compositions are often inadequate, that is to say known paving layers composed of bitumen, sand and stone do not have the intended service life, with the result that a road paving constructed from such layers has to be replaced after a relatively short time. Attempts have been made to raise the strength characteristics to a higher level. Thus, it is known to add polymers to the bituminous binders in order to modify said binders. Moreover, sulphur is used to improve the binder system and the mineral structure. Finally, it is known to use mica, silica fume and other substances in order to optimise the mechanical properties. These attempts do in fact have some result, but there is no question of an appreciable improvement in the strength characteristics.

An increase in the splitting strength and the flexural tensile strength and in the fatigue life is of importance, in particular, in the case of porous road paving material. The trend is to use this material to an increasing extent in the top layer of an asphalt road in order to remove rain water quickly. This promotes road safety. The porosity is achieved by using relatively little bitumen and a large amount of stone. This has a disadvantageous effect on the strength.

The object of the invention is to provide a process described in the introduction in which the strength characteristics of asphalt layers are appreciably improved in a simple, relatively cheap way.

According to the invention, chopped bundles of glass or mineral fibres are added to the composition in a percentage by mass of 0.2 to 0.8 with respect to the mineral constituents, the length of the filaments being between 5 and 50 mm, the diameter of the filaments at least 1 micrometer, and an adhesion-promoting protective coating being provided on the fibres. The fibres are therefore added in the mixer and not on the road.

If loose glass or mineral threads were to be added to the composition, poor mixing would occur. It is therefore essential that the glass or mineral fibres are introduced into the composition in the form of bundles chopped to certain lengths. The material of the fibres must be resistant to a temperature of up to 250° C. Plastic fibres are therefore not suitable. It is moreover of importance that the fibre bundles are loose and have not been woven, for example, into a mat or the like. The bundles usually comprise more than 100 filaments. An unduly high fibre content in the composition results in conglomeration and with unduly few fibres no reinforcement or virtually no reinforcement is achieved. Preferably, the fibre percentage is in the range between 0.2 and 0.4 % with respect to the mass of the mineral constituents.

Unduly long fibres result in inadequate mixability. On the other hand, with unduly short fibre pieces, entanglement occurs. The length of the filaments will also therefore be between 5 and 50 mm.

For practical reasons, the cross-section must not be unduly small. A minimum diameter of 1 micrometer is indicated. To provide the fibres with a mechanical pro-tection and to promote adhesion to the bitumen in the composition, a protective coating which promotes the adhesion may be provided on the fibres. Said coating may consist of chemically modified bitumen compositions. Examples are described, inter alia, in the US Patent Specification 4,166,752 and 4,251,577.

As regards mechanical protection, the coating forms an envelope which protects against breakage, the fibres also being protected against rubbing along each other.

The addition of glass or mineral fibres has a reinforcing effect on all the common asphalt compositions for road paving.

Examples are:

	Crushed Stone	Gravel	Sand	Filler	Bitumen %
Dense asphaltic concrete	50-65		30-45	approx.8	6-8% by mass
Open asphaltic concrete	60-75		20-35	approx.6	4-6% by mass
Very open asphaltic concrete	70-90		5-25	approx.5	4-6% by mass
Gravel asphaltic concrete		50-65		approx.6	4-5% by mass
Gravel asphalt	30-40		40-50	approx.20	8-12% by mass

The effect of adding chopped glass fibres will now be illustrated with reference to the following examples.

Example 1

Dense asphaltic concrete having a maximum stone size of 16 mm composed of crushed pebble, crushed sand, fine sand, flyash lime filler, 6.4 % bitumen 80/100

	Without glass fibre	With 0.4% fibre	Increase
Splitting strength	0.99 N/mm^2	1.20 N/mm^2	21%
Flexural tensile strength	2.9 N/mm^2	3.4 N/mm^2	17%

Example 2

Dense asphaltic concrete having a maximum stone size of 16 mm composed of broken stone/gres d'yvoir, crushed moraine sand, fine sand, lime filler, 6.0 % bitumen 80/100.

	Without glass fibre	With 0.4% fibre	Increase
Splitting strength	0.83 N/mm^2	1.02 N/mm^2	23%
Flexural tensile strength	2.7 N/mm^2	3.0 N/mm^2	11%
Fatigue life with repetitive loading (20° C)	N = 125,900	N = 354,800	180%

Example 3

Dense asphaltic concrete having a maximum stone size of 16 mm, composed of crushed moraine, crushed sand, fine sand, flyash filler, 6.4 % bitumen 80/100.

	Without glass fibre	With 0.2% fibre	Increase
Splitting strength	0.96 N/mm^2	1.08 N/mm^2	13 %

It was found that the favourable effects are independent of the nature of the crushed stone (crushed pebble, moraine, porphyry, diabase), of the crushed sand (crushed pebble, moraine), of the natural sand (river sand, shallows sand etc.), of the filler (powdered limestone, flyash, slaked lime) and of the bituminous binder (bitumen 45/60, 80/100 etc.).

In the above examples, the glass fibre monofilaments had a length of approximately 13 mm, the diameter was approximately 13 micrometers and the fibres were added in the form of chopped bundles of

fibres. The fibres were covered with a coating which promoted the adhesion to bitumen and forms a mechanical protection for the fibres.

Moreover, testing showed that the adding of chopped bundles of glass or mineral fibres in accordance with the invention has a favourable effect on the fatigue characteristics of asphalt.

Figure 1 shows an arrangement for a fatigue test.

Figure 2 shows a graph which reproduces the result of the fatigue test.

Fatigue tests for asphalt have been described in the annual report for 1976 of the Rijkswegenlaboratorium van Rijkswaterstaat (State Road Laboratory of the State Department of Public Works) and in LWL handbook no. 4, 1977 issued by the Rijkswaterstaat.

As Figure 1 shows, the fatigue tests are carried out with the aid of a four-point test arrangement in which an asphalt beam measuring 40 x 40 x 450 mm and clamped at four points is subjected to a sinusoidally varying load by means of a drive rod which is connected to a vibrator. The distance between the outermost support points is 400 mm and that between the two innermost support points is 130 mm. The frequency of the sinusoidal bending is 30 Hz and the bending has a constant amplitude. During the test, the force and the amount of bending are continuously measured as a function of the number of loadings. The tests can be carried out at various temperatures. The measurements appertaining to the values reproduced in the graph in Figure 2 have been carried out at 20° C. In Figure 2, the x axis represents the logarithm of the elongation in the outside of the asphalt beam and the y axis represents the logarithm of the number of loading cycles. The line A relates to a fibre-reinforced asphalt and the line B refers to an asphalt not reinforced with fibres.

Fatigue testing at constant force amplitude or constant elongation amplitude respectively corresponds best to the practical behaviour in the case where the asphalt layers in a road make the greatest or smallest contribution respectively to the total strength. On the basis of the fatigue behaviour measured in the laboratory, it is possible to determine the relative service life of different compositions in practice for dimensioning purposes.

Claims

1. Process for producing a composition to be used in road paving, comprising mixing mineral constituents such as gravel and/or crushed stone and sand with a bituminous binder in a mixer, characterized in that, in addition, in the mixer a content of bundles of glass or mineral fibres is added in a percentage by mass of 0.2-0.8 with respect to the mineral constituents, the length of the filaments being between 5 and 50 mm, the diameter of the filaments at least 1 micrometer, and an adhesion-promoting protective coating being provided on the fibres.

2. Process according to Claim 1, characterized in that the length of the filaments is between 5 and 30 mm.

3. Process according to Claim 1 or 2, characterized in that the coating is composed of chemically modified bitumen compositions.

fig-1

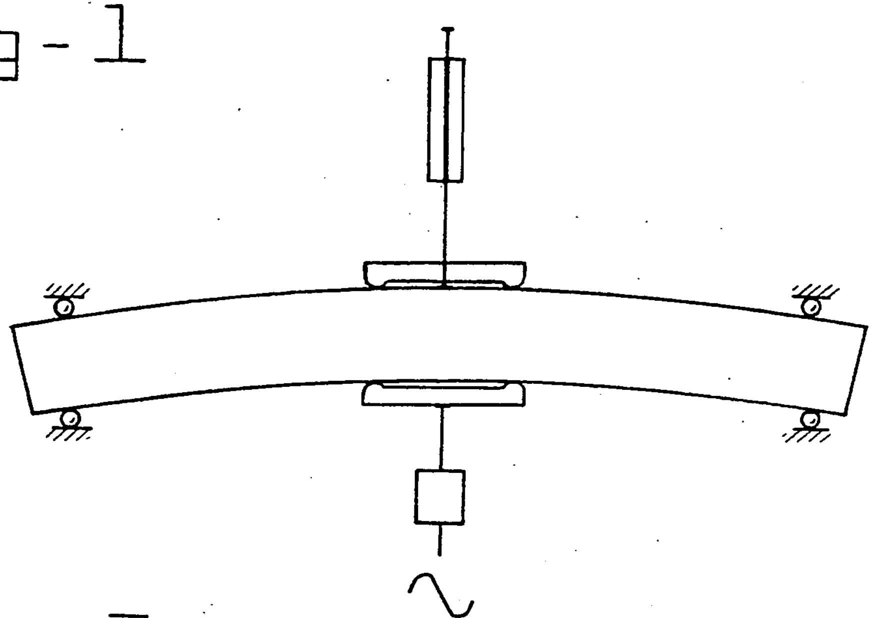
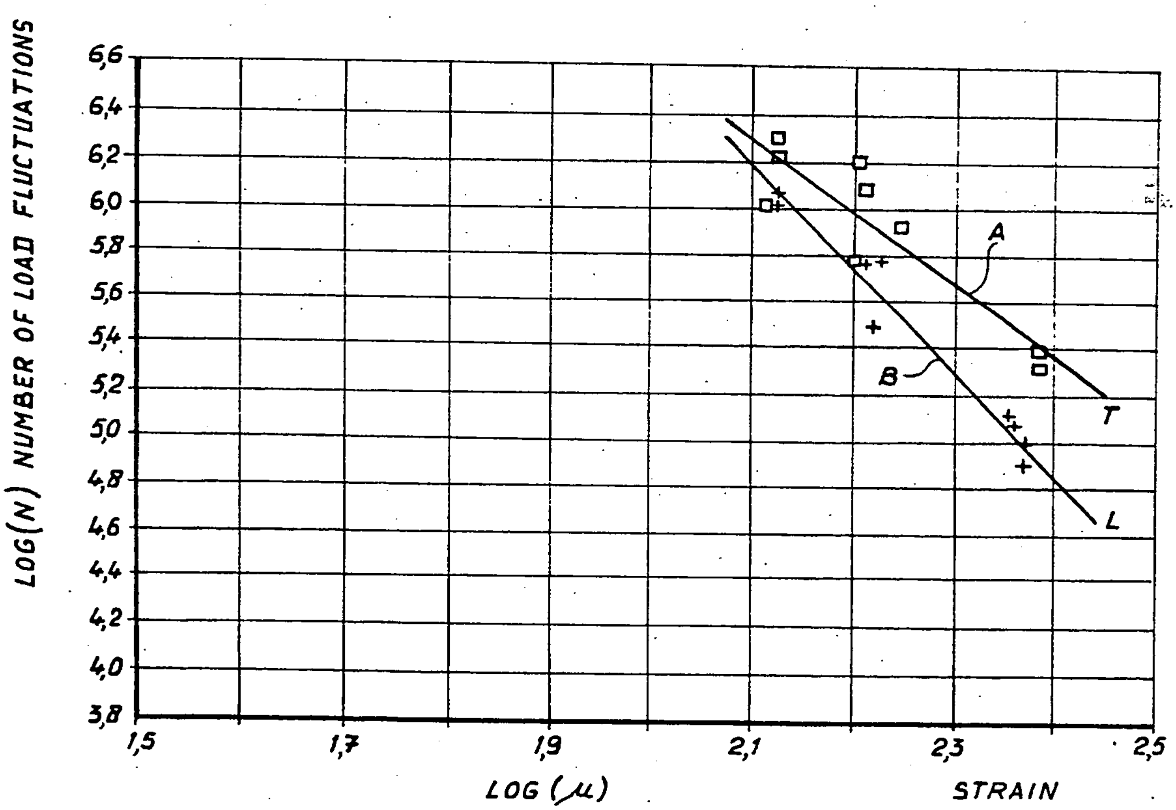


fig-2


LOG(N) NUMBER OF LOAD FLUCTUATIONS
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LOG (μ)
STRAIN
A
B
T
L

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EUROPEAN SEARCH REPORT

Application Number

EP 89 20 0678

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
D,Y	US-A-4 166 752 (A. MARZOCCHI et al.) * Abstract; column 4, lines 47-53 *	1-3	E 01 C 11/16 C 04 B 26/26 // (C 04 B 28/26 C 04 B 14:38 C 04 B 18:02)
Y	GB-A-1 537 663 (J. LAING & SON) * Claims 1,4,15,16; page 2, lines 110-119 *	1-3	
A	US-A-4 613 376 (N.-O. NILSSON et al.) * Claim 1 *	1	
A	US-A-2 893 889 (C.C. SCHUETZ et al.) * Column 5, lines 16-38 *	1,2	
P,A	EP-A-0 288 863 (S. RETTENMAIER) * Column 1, lines 25-26; column 2, lines 21-26; column 4, lines 33-36 *	1	
A	DE-C- 885 827 (EISENWERKE GELSENKIRCHEN) * Claim *		
A	DE-C- 919 205 (EISENWERKE GELSENKIRCHEN) * Claim *		

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

E 01 C 11
C 04 B 26
C 08 L 95

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	07-06-1989	DAELEMAN P.C.A.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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